ARGONNE NATIONAL LABORATORY
Pioneering Science and Technology

Safe disposal of spent commercial nuclear fuel

The Challenge – How to dispose of commercial nuclear waste

Commercial spent nuclear fuel is the major contributor to high level radioactive waste generated in the United States. With projected growth of nuclear energy, some estimates suggest the nation will accumulate well over 100,000 metric tons of spent fuel by 2050. But the Yucca Mountain Repository, by statute, can receive only 70,000 metric tons of waste. Worldwide projections of nuclear power growth suggest that eventually a new Yucca Mountain-sized repository will have to be built somewhere in the world every three to four years.

The Solution – Reduce the waste's volume, toxicity and heat load

Nearly all the risk from spent fuel comes from about one percent of its content – primarily the transuranics plutonium, neptunium, americium, and curium, and the long-lived isotopes of iodine and technetium. With these elements removed, the remaining 99 percent of the waste needs only about 1,000 years before its toxicity drops below that of natural uranium ore. Removing strontium and cesium with these wastes also reduces decay heat from the final waste form, which means that waste packages can be stored closer together, effectively expanding the repository's capacity. Transuranics will be separated from spent fuel and destroyed in advanced reactors.

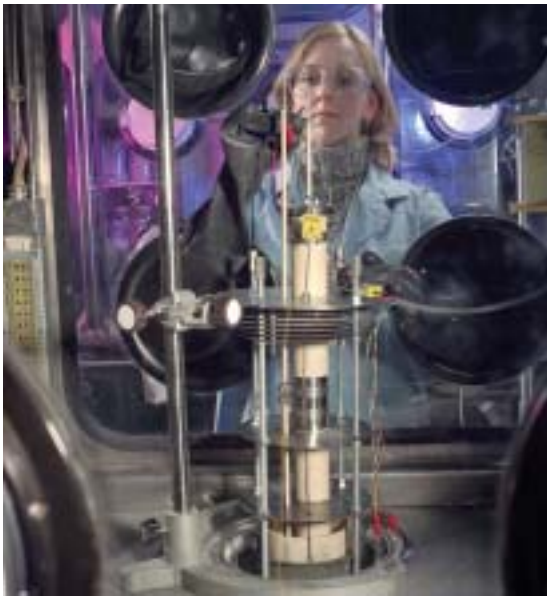
Argonne's Program

Argonne is working with the U.S. Department of Energy's Advanced Fuel Cycle Initiative to develop advanced proliferation-resistant technologies for treating and disposing of spent nuclear fuel. Under DOE's Generation IV program, Argonne is collaborating with several international partners to develop advanced, proliferation-resistant reactors and fuel cycle systems for possible deployment by 2030.

- Argonne is developing the UREX+ aqueous technology to close the fuel cycle for spent fuel from commercial light-water nuclear reactors. UREX+ is a multi-step process that uses discrete solvent extractions to separate (1) uranium, (2) technetium, (3) cesium and strontium, (4) plutonium and neptunium, and (5) americium, curium and minor actinides from spent fuel. Argonne has successfully demonstrated the entire process in hot cells and glove boxes and is preparing for scale-up demonstration.

- Pyroprocessing removes actinides from used fuel and recycles them into new fuel, thereby reducing their volume and toxicity. Integral to the process is the production of durable, leach-resistant waste forms, which Argonne and others are evaluating for the Yucca Mountain license. Pyroprocesses were successfully demonstrated from 1997 to 2000 by treating 118 fuel assemblies from an Argonne experimental reactor.

- Argonne is collaborating with international partners to design advanced reactors that will effectively transmute the most toxic constituents of waste. Some of these systems rely on well known technologies and are ready for large-scale demonstration.



LAB TEST — A researcher tests a nuclear fuel treatment process at Argonne National Laboratory. Argonne is developing technologies to reduce the volume and toxicity of spent reactor fuel to make it safer to dispose of and to permit future advanced reactors to use more of the energy in their fuel.

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